PREOPERATIVE CALCULATION OF IOL POWER AND ITS POST OPERATIVE EVALUATION

THESIS
FOR

MASTER OF SURGERY
[OPHTHALMOLOGY]

Approved

BUNDELKHAND UNIVERSITY
JHANSI U. P.

1999 PRADUMN AGARWAL

Dedicated to

My Father

My Inspiration

in life

CERTIFICATE

This is to certify that the work entitled "*PREOPERATIVE CALCULATION OF IOL POWER AND ITS POSTOPERATIVE EVALUATION* ", which is being submitted as a thesis for M.S. (Ophthalmology) Examination, 1999 of Bundelkhand University, has been carried out by Dr. Pradumn Agarwal in the Department of Ophthalmology , M.L.B. Medical College, Jhansi. This study has been conducted under my direct supervision and guidance. The observations recorded were periodically checked and verified by me.

This work fulfills the basic ordinances governing the submission of the thesis laid down by Bundelkhand University.

He has put in the necessary stay in the department as per University regulations.

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Dated : 4.1.99 (PRADUMN AGARWAL)

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INTRODUCTION

INTRODUCTION

Harold Ridley in 1964 made a comment : " I think the day is coming when we will no longer say to the patient , ' You have a cataract ; it must be removed ', but rather, ' your eye needs a new lens ; we can insert one'."

His prediction of replacing conventional cataract surgery by intraocular lens implantation surgery became undoubtedly true.Today at any center of the world the most commonly performed cataract surgery is replacing the cataractous lens with an artificial one.

Certainly the best way to rehabilitate the cataract patient is to put an intraocular lens. The main aim of this surgery is to provide the best possible optical rehabilitation for the patient. The choice of final refraction is an important aspect in lens implant surgery. The spherical error , amount of astigmatism and the amount of anisometropia are the three principal factors in the ultimate visual result and comfort to the patient.

This is to be understood that lens implantation is a one time surgery . The refractive power of the pseudophakos is final and the patient must live with any mistake committedin calculation of refractive power of the lens or he has to under go a very dangerous second stage surgery that is replacement of the IOL, Otherwise it can be corrected by extraocular aids like contact lens or glasses which indicates a total failure of the idea of IOL surgery.

It has been observed that a good number of patients present with significant amount of spherical error inspite of the best efforts made by the surgeon to give him a predictable post operative refraction. These post operative refractive surprises need to be minimised and avoided whenever possible.

There are many formula for determining the lens implant power, but choice of IOL power remains an art that requires careful consideration of different factors. Should the patient become emmetrope or myope following operation ? Should the postoperative refractive error be the same as the preoperative refractive error ? Do we want anisometropia ? What measure of aniseikonia may we expect the patient to tolerate ? All these questions need to be answered before choosing an implant power.

Anisometropia should be avoided, hyperopia should be decreased and myopes should be left myopic.A general tendency is towards emmetropia for younger , more atheletic patients, whereas approximately 2D myopia should be attempted for older, more sedentary patient.

It has been observed that the minimal error in the predicted refraction after implanting the IOL is the sum of random error in the estimation of axial length, the measurement of corneal power and the estimation of pseudophakic anterior chamber depth (ACD).

Our constant struggle to strive for perfection and precision leads us to the basic problem of minimising post operative refractive surprises after posterior chamber intraocular lens implantation which has become the surgery of the day. This has

led us to undertake this study to evaluate our present techinque and the factors responsible for affecting the precision and pitfalls in the IOL power calculation and achieving the desired postoperative refractive status.

Our continuous refinement in technique and efforts in this direction may one day enable us to not only achieve the desired refractive status with precision but also to take care of any preexisting refractive error particularly astigmatism.

AIMS & OBJECTIVES

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1. To assess the accuracy of calculating IOL Power by SRK formula.

2. To find out other factors if any influencing the post operative refraction results.

3. To test the hypothesis that such calculations may be unnecessary as a standard power IOL may be relied upon to reproduce postoperatively the preoperative basic refraction.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

CALCULATION OF INTRAOCULAR LENS POWER :

To ensure that our patients will have the optimal correction, the power of the lens to be implanted must be determined individually in every case . For this it is desirable to measure exactly the axial length of the eye. Weinstein et al (1966) showed that this can be accomplished better with ultrasound than with the formerly employed X-rays. In Germany, Gernet (1967) was first to work with "echometry". In subsequent years, several ultrasonic instruments were developed. Several investigators, first Gernet et al.(1970) and later C.D. Binkhorst (1981) developed useful formulas for calculation of IOL power.

CALCULATIONS DURING LENS PRODUCTION :

It is expected that the lens supplied by the manufacturer will have the exact diopteric power as demanded. The requirement is to know the diopteric power in water, since the refractive index of aqueous and vitreous (1.336 according to Gullstrand) is approximately the same as that of water (1.3329 at 20°for 589 mm wave length). The formula used to make different lens power is by determination of its radius of curvature.

$$R_{LENS} = \frac{N_{LENS} - N_{AV}}{D_{LENS}\text{ (in water)}}$$

Where :

R_{LENS} = radius of Pseudophakos in meter;

N_{LENS} = Refractive index of Pseudophakos (1.493 forPMMA)

N_{AV} = Refractive index of the aqueous andvitreous(1.336)

D_{LENS} = Desired power of pseudophakos in water.

Estimation of Lens Power to be implanted can be made by 2 methods :

1. on the basis of primary refraction
2. on the basis of measurements.

PRIMARY REFRACTION :

By primary refraction, we mean that refractive error that was present before cataract changes developed in the crystalline lens. Cataract especially the nuclear type,often causes a shift to myopia (secondary refraction). To discover the primary refraction a careful history has to be taken, including the kind of glasses the patient was using before. This can be verified reliably from the old records and profession of the patient. However,some of the refractive errors, especially in the case of monocular amblyopia or a high degree of ametropia may not have been corrected (R.D Binkhorst,1976).

When the primary refraction remains unknown an unpleasent post operative refractive surprises may occur. In these cases power calculation based on measurements using ultrasound is mandatory.

A +20.0 D lens in the posterior chamber adjacent to iris usually restores the primary preoperative error . This is known as "Idem" lens (since pre and postoperative refraction are the same).

Gernet and Zorkendorfer for (1982) have shown that the refractive power of the natural lens is +23.70 D. The cardinal plane of this lens is approximately 6mm behind the corneal apex. The distance for the cardinal plane of the posterior chamber lens (PCL) is less,however that is it is, farther removed from the retina. In order to focus parallel rays of light on the retina, it must be weaker than the natural lens.

A + 20.0 D artificial lens in the posterior chamber will restore the preoperative refractive error only if the natural lens indeed had about + 23.70 D refractive power. The refractive power of the eye is the result of combination of different factors, such as the corneal curvature, the distance of the lens from the cornea (the depth of anterior chamber), the diopteric power of the lens, and the length of the eye. Each of these values can deviate from the norms , and still an eye can be emmetropic as the different components compensate for each other. For instance, a rounder than normal lens is balanced by a flatter than normal cornea or the myopic effect of a longer eye can be offset by a flatter lens.

Therefore, using primary refraction as a basis to determine the power of the IOL to be implanted entails the possibility of significant errors. Deviations of 2D are common and more than 3D are not rare (Clevenger , 1978 ; Drews , 1977 ; Kraff et al ; 1978).

The reason for the probable incorrectness of the calculation is the impossibility of accurately assessing the position of the optic in the recipient eye in advance. The following considerations are to be made :

a) The diameter of the anterior chamber has some influence on the position of the optic of angle supported lenses with flexible haptics . Stiffer the haptic , more the tendency for the optic to vault forward (more with PMMA than with polypropylene).

b) There is a certain variation of the diameter of the ring formed by ciliary sulcus. If the diameter of the ring is small , then the optic of a sulcus fixated lens with a comparatively stiff haptic will be forced farther towards the retina.

c) Tightening of the posterior capsule postoperatively is also inassessable in advance. A tight posterior capsule will push the posterior chamber lens forwards towards the pupillary plane.

On the basis of these considerations , it seems that the calculations should be more accurate concerning angle fixated lenses with rigid haptic, iris clip lenses and lenses, totally in the capular bag than for other lens types.

CALCULATIONS OF POWER OF INTRAOCULAR LENS BASED UPON MEASUREMENTS :

The power of the intraocular lens can be calculated by different formulae if the following values are estimated :

i) Refraction of the surface of cornea.

ii) Axial length of the eye.

iii) Anticipated distance of the IOL from the anterior corneal surface.

REFRACTIVE POWER OF THE CORNEA

The refractive power of the cornea could be precisely measured from the radius of curvature of the anterior corneal surface by a keratometer. For refractive power of the anterior corneal surface the following formula is used :

$$P_{cornea} = \frac{N_{cornea} - N_{air}}{R_{cornea}}$$

Where Pcornea = Refractive power of the anterior corneal surface in Diopter.

Ncornea = refractive index of the cornea.

Nair = refractive index of air

Rcornea = radius of anterior corneal surface in meters.

A potential source of serious error in manual keratometry is the failure by the operator to caliberate the eyepiece to his or her eye . An error of 1D due to this failure to caliberate will translate to a 0.9 D error in implant power calculation or , 0.10mm mistake in reading the radius of curvature creates a O.5D error in the calculation of refractive power of cornea and an ultimate error of 0.45 D fault in IOL power calculation.

Another possible source of error is the index of refraction figure used to convert radius of curvature scale into diopters of power. In order to consider the divergent effect of the posterior corneal surface in the calculation, it is custoamary to choose for

the calculation of the air-cornea-chamber fluid/vitreous system a "fictitious refractive index" .

MEASUREMENT OF THE AXIAL LENGTH :

The axial length of the eye, from the apex of the cornea to the macula, is measured with an ultrasonic apparatus. Tissues of different density (the front and back surface of the cornea and of the lens, the retina) create peaks of high amplitude on the echogram. These peaks are utilised for the measurement of the length . Using a 10 MHz transducer , one can measure the length of the globe with an accuracy of within 0.1mm.

There are two basic methods of ultrasonic axial length measurement: the immersion, or water bath technique, and the applanation technique. With immersion technique , a small plastic eye cup is placed on the eye of a supine patient and filled with fluid. The ultrasound probe is placed in the solution , but is never allowed to come in contact with the eye. With applanation method, the patient is seated and an applanating cone is brought into contact with the anaesthetized cornea.

What actually measured is the time interval between echoes multiplied by the different tissue velocities. The sound waves pass through aqueous/vitreous at 1532m/sec, through normal crystalline lens at 1640.5m/sec. Cataract values range from 1590 to 1670 m/sec (average, 1629m/sec). In thin sclerotic lenses of less than 3.5 mm , it is about 1660m/sec (R.D. Binkhorst , 1977).

The echo that is of the greatest importance for the axial length comes from the anterior retinal surface .This , however, is not identical to the location of the optically important retinal element (cones). At least theoretically, the thickness of retina should be taken into consideration.The question arises of how great such a correction should be. The retinal thickness is 0.1mm only when the ultrasonic wave encounters the fovea. However, the wave as a rule , is bounced off the retinal area adjacent to the fovea. Therefore , one has to take the paramacular retinal thickness into the calculation. What the value of such correction should be is not quite clear. Colenbrander (1973)adds 0.5mm ; Thijssen (1979), 0. mm ; Buschmann (1979), 0.3 mm; and Gernet (1979), 0.2mm. Hoffer (1979) found that the most accurate result is obtained if the measured length is not altered, since this error is corrected by other errors in the system.

An error of 1mm of axial length measurement will result into an error of 2.50 D in IOL power calculation It is recommended that axial length should always be measured with dilated pupils [which cuts off disturbing echoes from the iris (pupillary margin)] .

ANTERIOR CHAMBER DEPTH.

The distance between the IOL and the cornea greatly influences the refractive power of the eye. The depth of anterior chamber is measured from the anterior surface of the cornea to the apex of the IOL.

Until recently , it was thought that the precalculation of the postoperative anterior chamber depth was

not possible . Calculations from the radius of curvature of the cornea and of the corneal diameter (Jaffe et al ., 1978) are too unreliable to have any practical importance. Even measurements of the preoperative anterior chamber depth with a specially equipped slit lamp (Pachymeter) or with ultrasound are without great practical significance , since the measured depth depends on the thickness of the natural lens, a factor that is not present after surgery.

It has been suggested that after cataract surgery pupillary plane in majority of cases is about 4mm behind the apex of the anterior corneal surface.

Hoffer (1979) studied the anterior chamber depth both preoperatively and following implantation with ultrasound and found some new values which could reduce the postoperative refractive values from ± 0.68 D to ± 0.27 D when applied properly.

He suggested that for posterior chamber lenses irrespective of preoperative measurement , a post operative anterior chamber depth of 4mm is employed for the calculation and with planoconvex lens having convex side placed towards posterior capsule with 10° forward angulation of the haptics, it should be 5 mm or slightly more.

CALCULATION OF POWER OF THE IOL FROM THE MEASURED VALUES :

Power of the IOL can be determined from the measured values by using different formulas. Using the described parameters ,namely, the refractive power of the cornea from the radius of the corneal curvature , the axial length of the

eye , as well as the assumed values of the cornea , lens distance and the shape (Biconvex -plano convex) and thickness of the IOL, we can calculate the power of the lens to be implanted . The pertinent rules were published by Gernet et al. as early as 1970, as well as by C.D.Binkhorst (1972 , 1973), R.D. Binkhorst (1974), Colenbrander (1973), Fyodorov et al . (1975), Gills (1980) , Retzlaff et al. (1982), Thijssen (1979), and Vander heijde (1975).

COLENBRANDER'S FORMULA :

Colenbrander's formula for his determination of the power of the planoconvex emmetropic lens is

$$P_{lens} = \frac{N_{AV}}{L_{eye} - (L_{CL}+d)} \qquad \frac{N_{AV}}{\frac{N_{AV}}{K} - (L_{CL}+d)}$$

Where P_{lens} = Power of the IOL (in diopters in water);

N_{AV} = refractive index of aqueous and vitreous = 1.336;

Leye = Axial length of eye (in meters) ; L_{CL}= distance of apexof the anterior corneal surface to the apex of the anterior surface of the IOL (in meters); K = refractive power of cornea in diopters ; d = distance of the second principal points of the IOL from the apex of its anterior surface, equals 0.00005 meters.

GILLS FORMULA :

The Gills method (1980), called "Computer Generated Intraocular lens power equation formula for the Binkhorst two-loop lens" is

$$P_{Lens} = 129.404739 + (-1.08023 \times K) + (-2.793507 \times L_{eye}) + (0.262593 \times L_{CL}) + (-0.384961 \times Ref.)$$

Where P_{Lens} = Lens Power needed for desired postoperative refraction (Spherical equivalent)

K = refractive power of cornea in diopters.

Leye = axial length of eye in millimeters

L_{CL} = distance of apex of the anterior corneal surface to the apex of the IOL in millimeters.

Ref. = desired postoperative refraction (spherical equivalent)

This formula takes into account not only the corneal curvature and axial legnth of the eye, but alo the anterior chamber depth.

SRK FORMULA :

This formula developed by Sanders, et al (1981) ; Retzlaff, et al (1982) and Kraff (1980) has become the most widely used formula for implant calculation.

The SRK formula is :

$$P = A - 2.5L - 0.9K$$

Where P = implant power to produce emmetropia (diopters).

A = the specific constant for each lens type and/or manufacturer

L = axial length (mm)

K = average keratometer reading (diopters).

MODIFICATION OF SRK TO SRK II FORMULA :

SRK formula works well for eyes with axial lengths of 22-24.5mm, which make up about three out of four cases, but that for shorter or longer eyes modifications are required to improve predictabilty . The SRKII formula recognises this as follows :

SHORT EYE :

axial length 21-22 mm,add 1 to usual A constant

axial length 20-21 mm,add 2 to usual A constant

axial length less than 20 mm, add 3 to usual A constant

LONG EYE :

Over 24.5mm subtract 0.5mm from usual A constant. To produce an intentional ametropia the calculated power for emmetropia is modified as follows:

$$P_{AM} = P_{EM} - \frac{P_{SP}}{R_F}$$

P_{AM} = is the required IOL power to produce a final spectacle power of P_{SP}.

P_{EM} =IOL power calculated to produce emmetropia

R_F = 0.8 for P_{EM} > 14D and 1 for P_{EM} <14D.

CLAYMAN'S FORMULA :

It was Suggested by Clayman (1981) as a "ready reckon" method quoted here verbatim from AIOIS Journal , Jan .1981.

Assume as follows :

1. The emmetropizing IOL = 18D (irrespective of type)
2. The emmetropic axial length = 24.00mm.
3. The emmetropic average keratometer (K) reading is 42.00 D
4. One mm. in axial length = 3D of IOL power
5. Consider keratometry is 1D = 1D

6. When this method calls for an IOL greater than 21D , deduct 0.25D for every diopter greater than emmetropia (18.00 D)

MAWAS FORMULA(EUREKA)

Mawas (1984) reported a modification of the SRK formula. According to this formula, one calculates the mean " L " (axial length) ; calculates the mean "K" ; considers the results as a normal emmetropic eye ; subtracts the individual readings.

In the Mawas formula the emmetropic normal eye's axial length L = 23.2 mm. The K-reading using the index number of 1.3376 is 43.25 D.

A review of literature was made to evaluate the prediction accuracy of intraocular lens calculations. A uniform standard formula (Percentage ± 1.0 diopter/ percentage ±2.0 diopter/range of error) for reporting accuracy was used to evaluate the accuracy of reports in the literature as well the accuracy of an ultrasound unit (Kretz 7200 MA), the Hoffer formulae, use of a standard 3.5mm anterior chamber depth, and addition of a retinal thickness factor to the measured ultrasound axial length. The appropriateness of technician performing this procedure was also evaluated. Results of previous studies show that the use of another ultrasound unit (Sonometrics DBR) and Binkhorst's formula is the least clinically accurate method .(Hoffer Kenneth J M.D.,1981).

Holladay and Prager et al, reviewed the intraocular lens power calculations on 512 posterior chamber lens implantations

and determined 4 ways to reduce the estimated 5% incidence of large postoperative refractive "surprises" (Greater than 2D). First, preoperatively identify those patients who have greater than 1D difference between the theoretical and linear regression formula. Second, repeat axial length and corneal power measurements in these patients to eliminate random error.Third, develop an individualized theoretical formula that accounts for constant bias. Fourth , encourage manufacturers to improve instrumentation for measuring corneal power and axial length . (Holladay and Prager et al, 1986.)

In 1982 , Jeffrey S. Hillman studied series of 50 eyes that received an IOL of power calculated for emmetropia from data of axial length , corneal curvature and post operative anterior chamber depth by R.D.Binkhorst's formula . The postoperative refraction results were compared with those of 100 control eyes which received +19 D standard power IOL's without calculation. The calculated group had postoperative refractions which were closer to emmetropia, and the difference was of statistical significance , with 92% within the ± 1D range and 98% within the ± 2D range from emmetropia. The calculated predictions of postoperative refraction were of a useful level of accuracy. Consideration of the sources of error indicate that there is no justification for the use of IOL's in power steps of less then 1D. (Jeffrey S. Hillman,1982).

A prospective study of 25 eyes, received an intraocular lens of power calculated for planned ametropia, by means of the formulae of R.D. Binkhorst. All the postoperative refractions were within ± 2D range from the predicted refraction,

confirming the clinical value of such calculation. A retrospective study of 100 eyes which had received a+19D power Binkhorst IOL showed a wide range of change in refraction extending up to the ± 6D range, indicating that a 'standard' power IOL cannot be relied upon to reproduce the preoperative refraction. (Jeffrey S. Hillman,1983).

In 1991, P.Mc Cormack et al. carried out a retrospective study of 90 eyes of 88 myopic patients who underwent ECCE with IOL implantation. IOL power was calculated by SRK and modified SRK (SRK II) formulae. Using the SRK formula the average absolute error was 2.16D with a range of -7.2 D to + 8.5 D. Using SRK II formula the average absolute error was 2.07 D with a range of -3.5 D to +7.8 D. The study suggests that the prediction accuracy of IOL power is reduced in patients with axial myopia. The sources of error may be :

1. A relatively small error in alignment of the ultrasound beam in a long eye will induce a proportionately larger error in the measured axial length. 2. If the ultrasound beam misses a posterior pole staphyloma the axial length will be falsely short 3. The anterior chamber depth will be greater in the long eye and thus A constant of the IOL may well be incorrect. (Mc Cormack et al. 1991).

Oslen T studied the sources of error in IOL power calculation. Measurements were made in 584 consecutive patients with phacoemulsification or planned extracapsular cataract extraction and in the bag implantation of the PCIOL. Axial length and anterior chamber depth were measured using

A-Scan with a solid transducer probe. 54% of total error was ascribed to errors in measuring axial length, 8% to errors in measuring corneal power, and 38% to errors in estimating postoperative anterior chamber depth when a fixed anterior chamber depth was used in power calculations. If however, the anterior chamber depth was predicted by a regression method, this source of error was reduced to 22%. As a result, the total refractive prediction error declined from ± 1.03 to ± 0.92D. He hypothesized that the minimal error in predicted refraction after implanting an IOL is the sum of random error in the estimate of axial length, the measurement of corneal power, and the estimated depth of pseudophakic anterior chamber (Oslen T, 1992).

Longstaff S. studied three groups of patients using SRK regression formula. The effect of inaccurate use of formula of choice was shown and need to modify the A-Constant to account for variation both in technique and biometry equipment emphasised. The variation in results due to inaccurate biometry were statistically assessed. Accuracy of IOL power requires consistency but not absolute accuracy in biometry . No ocular factors were found to affect the accuracy of IOL power calculation (Longstaff S; 1986).

In 1985, Gregory and Esbester et al. assessed the accuracy of routine preoperative biometry and reviewed all cases of extracapsular cataract extraction with posterior chamber implant performed at Queen Alexendra Hospital.Of 471 eyes included in the survey, 67.9% were within 1.0D of the expected

refraction and 90.7% within 2.0D. The necessity of routine pre-operative biometry is emphasised (Gregory and Esbester et al.1989).

Sixty five patients underwent intracapsular cataract extraction with implantation of Binkhorst iris clip intraocular lenses(IOL's). For 31 patients the IOL was of a standard power, 34 patients had axial length measurements and keratometry preoperatively and IOL's calculated to produce emmetropia or 1 dioptre of myopia were implanted. There was no significant difference in the range of postoperative refractive results between the two groups (Thompson and Roberts Mohan, 1986).

94 patients underwent extracapsular cataract extraction and insertion of Sinsky style two loop posterior chamber intraocular lenses. 46 eyes received a standard power IOL (19.5D ± 0.5D) and 48 eyes were given a preoperatively calculated IOL. (16-25D) . A significant difference was found in the two groups with regard to the postoperative refractive error and uncorrected visual acuity (Singh and Dahalan, 1987).

A retrospective survey of 612 eyes that had undergone cataract extraction and IOL implantation to evaluate the accuracy of ultrasound biometry combined with keratometry using SRK regression formula , for the preoperative prediction of intraocular lens power, was done. A mean error of + 0.35 diopter sphere(S.D.± 0.98) was found for the series overall with a significant ($P<0.005$) difference between the distribution of postoperative refractive errors using the SRK formula for IOL prediction and the use of a standard lens of 19.5D . The consistency of results was tested for those patients with greater

or less than normal axial length. The linear regression and analysis showed no correlation between axial length and postoperative refractive error and therefore does not support the adjustment of predicted IOL powers by a factor based on axial length. Statistically significant difference was found between surgeons results, supporting the practice of "A" constant modification of individual surgeons.

In 1988. Holladay and Rubin studied methods for calculating the postoperative refraction and refracting the pseudophakic patients after surgery. A good visual result after cataract surgery and IOL implantation depends upon preoperative determination of an ideal post-operative refraction. This will depend on the refractive error in the other eye and whether the cataract is monocular or binocular.

A survey on lens implant exchanges for incorrect power was done .Despite the introduction of ultrasonic axial length measurements and a variety of intraocular lens implant prediction formulae, postoperative predicted errors greater than 2 diopters occur in approximately 5-10% of lens implantations, and occasional errors of 5 diopters to 7 diopters or greater are still encountered. An informal survey revealed successful lens implant or exchanges for initial post-operative refractive errors of + 4.37 to +14.0 D in eight eyes (Salz and Reader , 1988).

A study for error in prediction of emmetropic intraocular lens power or post operative refractive error after posterior chamber lens implantation was done. Regression line calculation with the SRK formula or with a group specific regression was compared with theoretical calculations in

unselected, long myopic and short hyperopic eyes. The cut off length was below 22.0 mm for the short eyes and 25.9 mm for long eyes. In the unselected and hyperopic group , there was only a small difference in mean error and error variance when the three calculation methods were compared. In the high myopic group , the range of errors increased in all methods . The worst results were obtained with the standard SRK equation because the slope of the regression line in myopic eyes differs from the classical regression line calculated on an average population of implants. Lens calculation in high myopic eyes should therefore be performed with a specific regression line or by theoretical calcultion (Huber C, 1989).

Limdi and Sheth predicted the intraocular lens power in 100 patients using the ophthasonic A-scan unit by S.R.K. formula, using axial length and keratometry as inputs. The accuracy of prediction of IOL power was calculated by noting the disparity between the expected postoperative refraction and the actual refraction obtained after one and half months of IOL implantation. The results obtained were encouraging; the maximum deviation from the expected result being ± 3.2 D (Limdi and Sheth, 1991).

MATERIAL & METHODS

MATERIAL AND METHODS

The present study is carried out in the Department of Ophthalmology , M.L.B. Medical College & Hospital , Jhansi. The patients of senile and presenile cataract admitted in the eye ward during a period of one year were analsyed. Our case material is then grouped as:

(a) CONTROL GROUP (GROUP A) : Patients, in which a +21 D standard power posterior chamber intraocular lens was implanted, were taken as control for present study.

(b) STUDY GROUP (GROUP B) : 30 patients, in which the intraocular lens of calculated power according to SRK formula was implanted in the posterior chamber , were taken as study group for present study. The patients with history of high refractive error were not taken . All the patients were subjected to a detailed clinical examination including:

1. History: A detailed history of primary refraction i.e. refractive error that was present before cataract changes developed in the crystalline lens was taken.

Past and present history of local, general and systemic illnesses was taken as usual with special reference to elicit the factors which govern the power of the IOL to be implanted .

2. Examination : Detailed ocular examination was done under bright light and with the help of loupe and slit lamp to see

the status of cornea , depth and contents of anterior chamber, condition of the iris and lens for type and maturity of the cataract.

Intraocular tension was measured by Schiotz tonometer . Syringing was done to see the patency of nasolacrimal duct.

All patients in study group were examined by keratometer to measure the corneal power. Both horizontal and vertical meridians were measured. Mean (K)of the two values (K1 and K2) were used for IOL power calculation.

Axial length of the eyes in study group was measured with the help of A-Scan using following technique :

1. Patients lying supine
2. 2% lignocaine drops were instilled for topical anaesthesia.
3. Patient fixing at a distance.
4. Contact technique used for measurement of the axial length by touching the center of the cornea with the ultrasound probe without indenting it. Five echospikes are identified on the screen of the biometer and axial length displayed is noted.

Axial length as measured by the biometer and average keratometry reading are fed into the computer of the biometer and intraocular lens power is calculated by SRK formula as follows.

$$P= A-2.5L - 0.9 K$$

Where P= Power of the intraocular lens for emmetropia in diopters.

A= A - Constant (118.2 was used in all cases).

L= Axial length of the eye in mm.

K= Average keratometry reading.

Power of the lens for emmetropia was noted. Routine preoperative investigations were carried out in all cases , which include :

a) Complete hemogram

b) Blood sugar estimation

c) Blood pressure measurement

After obtaining informed consent the patients were subjected to extracapsular lens extraction with posterior chamber intraocular lens implantation. Lens of nearest power was implanted and the achieved post operative refraction evaluated against the estimated post operative refraction.

OPERATION TECHNIQUE

(i) Preoperative Medications

a. Topical antibiotic four times a day instilled in the affected eye started 1 day prior to surgery.

b. Pupillary dilatation is achieved by the topical use of Tropicamide and phenylephrine combination with flurbiprofen eye drops.

c. Preoperatively tension was lowered by means of oral acetazolamide or IV mannitol if needed.

d. Xylocaine sensitivity was done in all cases.

ii Operative Steps

The operations were done under local anaesthesia which was achieved by a peribulbar block using 2% Lignocaine with adrenaline combined with enzyme hyaluronidase.

A superior rectus suture was passed to hold the globe in the most convenient position for surgical procedure.

After making a limbal based conjunctival flap a corneoscleral incision was given.

Canopener capsulotomy was done in closed chamber under methylcellulose. The incision was extended from 10 o' clock to 2 o' clock position. Cortical matter aspiration was done by irrigation aspiration cannula after the delivery of nucleus. Modified C loop biconvex posterior chamber intraocular lens was implanted either by dialling technique or flexing or looping technique.

Wound closure was done by 10-0 monofilament polyamide either by interrupted stitches or continuous shoe lace technique.

All cases were operated under LEICA operating microscope with coaxial illumination.

Subsequently the patients were kept in the hospital for a period of at least 2 days . Topical medication comprising of a combination of chloramphenicol and dexamethasone eye drops was applied 4 times a day for a period of 6 weeks. A short acting cycloplegic was used if and when necessary. Topical timolol 0.5% drops was used twice a day for 4 weeks . Systemic antibiotics, steroids and anti inflammatory was used.

Following factors were noted in each follow up visit:

Postoperative complications like severe iridocyclitis, corneal oedema, rise in intraocular pressure , wound gape.

- Position of the lens to rule out any decentration, tilt or malposition.
- unaided visual acuity and improvement with pinhole in each visit was noted.
- Fundus examination to exclude any pre-existing retinal, macular or optic nerve disease and development of cystoid macular oedema.

Final post operative refraction and glasses were prescribed at the end of 6th week.

The spherical equivalent of the postoperative refraction and the various factors that could affect it have been studied and the results in the two groups have been compared to assess the accuracy of IOL power calculation by SRK formula , and to test the hypothesis that such calculations may be unnecessary as a standard power IOL may be relied upon to reproduce postoperatively the preoperative basic refraction .

OBSERVATION

OBSERVATIONS

The present study was carried out in 60 cases at the Department of Ophthalmology , M.L.B. Medical College & Hospital, Jhansi . Among 60 cases ,30 cases were taken as control group (Group A) in which a + 21 D standard power posterior chamber intraocular lens was implanted , and 30 cases were taken as study group (Group B) in which the posterior chamber intraocular lens of calculated power was implanted . The patients with history of high refractive error were not taken .

TABLE No. 1

SEX DISTRIBUTION OF CASES

Groups	Total No. of Cases	No. of cases	
		Male	Female
Group A	30	10 (33%)	20 (67%)
Group B	30	11 (37%)	19 (63%)

In Group A , 10 (33%) patients were male and 20 (67%) patients were female , while in Group B , 11 (37%) patients were male and 19 (63%) patients were female .

The number of female patients was more as compared to male .

The ratio of male : female in Group A is 1 : 2 while in Group B it is 1 : 1.7 .

TABLE No. 2

AGE DISTRIBUTION OF CASES

Age in Years	No. of cases	
	Group A	Group B
< 50 Years	4 (13%)	5 (16%)
51 - 60 Years	15 (50 %)	16 (54%)
> 60 Years	11 (37%)	9 (30%)

In Group A , 4 (13%) patients were in < 50 years age group , 15 (50%) patients were in 51 - 60 years age group and 11 (37%) patients were in > 60 years age group .

In Group B , 5 (16%) patients were in < 50 years age group , 16 (54%) patients were in 51 - 60 years age group and 9 (30%) patients were in > 60 years age group .

The maximum age was 75 years and minimum age was 42 years in Group A whereas in Group B maximum age was 72 years and minimum age was 48 years .

TABLE No. 3

PREOPERATIVE VISUAL ACUITY

Visual Acuity	Group A	Group B
Hand Movement	17 (57%)	18 (60%)
1/60 - 5/60	13 (43%)	11 (37%)
6/60	O	1 (3%)

Table - 3 shows best corrected preoperative visual acuity in Group in A & B .

In Group A , the eyes were found to have visual acuity of hand movement in 17 (57%) cases , 13 (43%) had visual acuity of 1/60 - 5/60 and no patient had visual acuity of 6/60 .

In Group B , the eyes were found to have visual acuity of hand movement in 18 (60%) cases , 11 (37%) had vision of 1/60 - 5/60 and 1 (3%) had vision of 6/60 .

TABLE No. 4

PREOPERATIVE REFRACTIVE STATUS

Preoperative Refractive status	Group A	Group B
Hypermetropic	3 (10%)	4 (13%)
Myopic	7 (23%)	8 (27%)
Emmetropic	20 (67%)	18 (60%)

A careful assessment of preoperative refractive status of the patients was done in all the cases as is shown in Table No. 4 .

In Group A , majority of patients 20 (67%) were emmetropic , 7 (23%) were myopic and 3 (10%) hypermetropic .

In Group B , majority of patients 18 (60%) were emmetropic , 8 (27%) were myopic and 4 (13%) were hypermetropic .

TABLE No. 5

KERATOMETRY

Average keratometric Reading	No. of Patients Group B
4 2.00 - 44.00 D	20 (67%)
4 4.25 - 46.00 D	7 (23%)
4 6.25 - 47.50 D	3 (10%)

The patients in Group B were subjected to keratometry .

The lowest average keratometric reading was found to be 42.00 D and the highest was 47.50 D . 20 (67%) patients had average keratometric reading in the range of 42.00 - 44.00 D , 7 (23%) patients had reading in the range of 44.25 - 46.00 D and 3 (10%) had reading in the range of 46.25 - 47.50 D .

TABLE No. 6

AXIAL LENGTH

Axial Length	No. of patients Group B
21.00 - 22.00 mm	3 (10%)
> 22.00 - 23.00 mm	5 (16%)
> 23.00 - 24.00 mm	22 (74%)

In all patients in Group B axial length was measured by A-Scan.

The lowest axial length measured was 21.12 mm , while the highest recorded was 23.53 mm in our study.

3 (10%) patients had axial length between 21.00 to 22.00 mm, 5 (16%) patients between > 22.00 - 23.00 mm and 22 (74 %) patients between > 23.00 - 24.00 mm.

TABLE No. 7

POWER OF IOL IMPLANTED

IOL POWER	No. of Patients Group B
+ 21.00 D	8 (27%)
+ 21.50 D	15 (50%)
+ 22.00 D	7 (23%)

The power of the IOL's used in Group B is shown in table No. 7.

+ 21.00 D Lens was implanted in 8 (27%) cases

+ 21.50 D Lens was implanted in 15 (50%) cases.

+ 22.00 D Lens was implanted in 7 (23%) cases.

TABLE No. 8

POST OPERATIVE VISUAL ACUITY

VISION	UNCORRECTED		CORRECTED	
	Group A	Group B	Group A	Group B
6/6	0	2 (7 %)	15 (50 %)	16 (54 %)
6/9	1 (3 %)	4 (13%)	8 (27 %)	10 (33 %)
6-12	8 (27 %)	13 (44%)	7 (23 %)	4 (13 %)
6/18	2 (7 %)	10 (33%)	0	0
6/24	4 (13 %)	1 (3%)	0	0
6/36	12 (40 %)	0	0	0
6/60	3 (10%)	0	0	0

The postoperative visual acuity, uncorrected and corrected in both groups is shown in Table No. 8

The postoperative uncorrected visual acuity in Group A was 6/36 in maximum number of patients 12 (40%) , 8 (27%) patients had 6/12 , 4(13%) had 6/24 , 3 (10%) had 6/60, 2 (7%) had 6/18 and 1 (3%) had 6/9. No patient had uncorrected postoperative visual acuity of 6/6.

The postoperative uncorrected visual acuity in Group B was 6/12 in maximum number of patients 13 (44 %) , 10 (33%) had 6/18,4(13%)had6/9 , 2(7%) had 6/6 while 1 (3%) had 6/24.

The corrected visual acuity was almost similar in two groups. In Group A , 15 (50%) patients achieved 6/6 vision, 8 (27%) achieved 6/9 and 7 (23%) patients achieved 6/12 vision.

In Group B, 16(54%) patients achieved 6/6 vision , 10 (33%) achieved 6/9 & 4 (13%) patients achieved 6/12 vision.

TABLE No. 9

ACHIEVED REFRACTION

Range (in Diopters)	Group A	Group B
0 - ± 0.5	2 (7%)	6 (20 %)
> ± 0.5 - ± 1.0	9 (30%)	16 (54 %)
> ± 1.0 - ± 1.5	6 (20%)	4 (13%)
> ± 1.5 - ± 2.0	8 (27%)	4 (13%)
> ± 2.0 - ± 3.0	4 (13%)	0
> ± 3.0 - ± 4.0	1 (3%)	0

The achieved refraction in both the groups is shown in Table No. 9

At the 6th week postoperatively all the patients were refracted under cycloplegia. The spherical component of the refraction was considered for evaluating the study factors.

In Group A the postoperative refractive status achieved was within ± 0.50 D of emmetropia in 2 (7%) patients , 9 (30 %) within > ±0.5 D - ± 1.0 D , 6 (20%) within > ± 1.0 D - ± 1.50 D, 8 (27%) within > ± 1.50 D to ± 2.0 D and 4 (13%) within ± 2.0 D -± 3.0 D and 1 (3 %) within > ± 3.0 D - ± 4.0 D.

In Group B, the postoperative refractive status acheved was within ± 0.50 D of emmetropia in 6 (20%) patients, 16 (54%) patients , within > ± 0.5 0 D - ± 1.0 D, 4 (13%) patients within > ± 1.0 D- ± 1.50 D , 4 (13%) within > ± 1.5 D - ± 2.0 D.

The maximum refractive error obtained in Group A was -3.50D while in Group B was + 2.0D.

DISCUSSION

DISCUSSION

The aim of our study was :

1. To assess the accuracy of calculating IOL power by SRK formula .
2. To find out other factors if any influencing the postoperative refraction results .
3. To test the hypothesis that such calculations may be unnecessary as a standard power IOL may be relied upon to reproduce postoperatively the preoperative basic refraction .

A total of 60 cases were selected of which 30 were taken as control group (Group A) in which a + 21.0 D standard power posterior chamber intraocular lens was implanted and 30 were taken as study group (Group B) in which the posterior chamber intraocular lens of calculated power was implanted. The patients with history of high refractive error were not taken. The patients were selected randomly without any age or sex bias .

SEX DISTRIBUTION OF CASES :

In our study it is evident that in Group A , the majority of cases 20 (67%) were females and 10 (33%) were males & in Group B , 19 (63%) were females and 11 (37%) were males . The ratio of male : female in Group A is 1 : 2 while in group B it is 1 : 1.7 .

This is in close agreement with the prior study done by Jeffrey S . Hillman (1982) in which 42% patients were male and 52% patients were female in the

control group whereas in the study group 36% were males and 64% were females.

The probable reason for more number of females in our study seems to be that most of the male patients prefer to go to private clinics rather than going to a Government Hospital.

AGE DISTRIBUTION OF CASES :

According to our study, in Group A, maximum number of patients 15 (50%) were in the age group 51-60 years, 4 (13%) were in < 50 years age group and 11 (37%) were in > 60 years age group.

Similarly in Group B, maximum number of patients 16 (54%) were in the age group 51 - 60 years, 5 (16%) were in < 50 years age group and 9 (30%) were in > 60 years age group.

The age distribution of cases in the two group is equal.

According to Peyman, Sanders and Goldberg only 4.6% persons aged 50 to 60 years develop senile cataracts but in our study maximum number of patients were in this age group.

The reason seems to be early appearance of cataract in Indian population by about a decade due to tropical climatic conditions (Javitt J Sommer A and Venkataswamy G, 1983, Hiller R Giacometti L and Yuen K ; 1977).

PREOPERATIVE VISUAL ACUITY:

Our study shows that in Group A as well as in Group B , maximum number of patients 17 (57%) and 18 (60%) respectively , had visual acuity of hand movement , and none in Group A and only 1 (3%) in Group B had visual acuity of 6/60 .

This seems to be because most of the cases in our study were rural population of Bundelkhand region and were farmers and most of them had to do unskilled work and also because of the disbelief that cataract should be operated only when it has become completely mature .

PREOPERATIVE REFRACTIVE STATUS :

In our study , most of the patients 20 (67%) in Group A were emmetropic , similarly in Group B also , maximum number of patients 18 (60%) were emmetropic . This could be because most of the patients in our study were females from the rural background and they never used glasses either because of social stigma or because they were farmers and they had to do unskilled work and also that patients with history of high refractive errors have been eliminated from our study .

KERATOMETRY

Our study shows that maximum number of patients 20 (67%) ,in Group B had average keratometric reading between 42.00 - 44.00 D .

As most of the patients in our study were emmetropic preoperatively , hence our findings coincide with the normal

refractive power of the cornea (+43.0 D) as reported by Alpar JJ, Fechner PU.

According to Holladay et. al (1986), keratometry is a very important factor for the accurate calculation of IOL power .

Oslen T (1992) , reported that 8% errors in calculating IOL powers were due to imperfect measurement of corneal power

Alpar JJ , Fechner PU. and Jaffe N.S. , Horwitz J describe that 0.1 mm. mistake in reading the radius of curvature creates a 0.5 D error in the calculation of the refractive power of the cornea. This result in 0.45 D fault of the IOL.

AXIAL LENGTH

In our study maximum number of patients 22(74%) in Group B had axial length of > 23 - 24.00 mm.

Duke Elder describes that the average values for the axial length is between 23.00 - 24.00 mm for emmetropic eyes.

As most of the patients in our study group were emmetropic , our findings are in accordance with him .

Oslen T (1992) has considered axial length to be a major factor in IOL power calculation. He reported 54% of total errors in intraocular lens power calculation was due to errors in measuring axial length.

P. Mc Cormack (1991) suggested that the prediction accuracy of IOL power by SRK formula is reduced in patients with axial myopia.

Prior et. al (1988) reported that there is no correlation between axial length and postoperative refractive error.

Huber (1989) said that in high myopic group , worst results were obtained with the standard SRK equation as compared with other formulas.

In our study , patients of high refractive errors have been eliminated , therefore , chances of errors in predicting IOL power by SRK formula was minimised .

POWER OF THE IOL IMPLANTED

The IOL power was calculated for Group B by standard SRK formula. In some cases we had to implant IOL of power nearest to the desired power and the achieved postoperative refraction was evaluated accordingly.

The evaluation was done according to the rule stated by Alpar JJ ,Fechner PU. , that " every alteration of the lens to be implanted will affect the postoperative refraction by 80%".

POST OPERATIVE VISUAL ACUITY

As is evident in our study, the post operative corrected visual acuity was similar in both groups , with 15 (50%) patients having visual acuity of 6/6 in Group A and 16 (54%) patients in Group B. However, there was a significant difference in the uncorrected post operative visual acuity in the two groups.

The maximum number of patients 12 (40%) in Group A had uncorrected visual acuity of 6/36 whereas in Group B maximum number of patients 13 (44%) had uncorrected visual acuity of 6/12. No patient in Group B had visual acuity of 6/36 and 6/60 , whereas , in Group A maximum number of patients were having vision of 6/36 and 3 (10%) patients had vision of 6/60.

In our study 64% patients in Group B could see 6/12 or better uncorrected as compared with only 30% patients in Group A . These findings compare favourably with 58.3% of patients in study group and 32.6% patients in control group as reported by Singh Mohinder and Dahalan (1987).

This shows that although patients in Group A could achieve a good corrected visual acuity post operatively similar to Group B but their power of correction was higher.

ACHIEVED REFRACTION

As is evident, in Group A , we could achieve a refraction within ± 1.0 D of emmetropia in only 37 % patients , within ± 2.0D of emmetropia in 84% patients . This leaves 16 % eyes with ametropia greater than these limits and some surprisingly large refractive errors are to be expected.

In Group B we could achieve a refraction within ± 1.0D of the emmetropia in 74% of cases and within ± 2.0D in 100% patients.

Similar observations have been reported in prior studies. Jeffrey S. Hillman (1982) reported 94% within ± 2.0D range , 96% reported by Maloney et al. (1979), 93% reported by Kraff et al. (1978) , 99% reported by Thomas Oslen (1987), 96% reported by Limdi and Sheth (1991), within ± 2.5D in 97.2% reported by Johns (1979) , within ± 3.0 D in 97% reported by Clevenger (1978).

A comparative study of different formulae done by US study group showed 83% < 1D deviation from the predicted power and 97% < 2 D deviation from the predicted power when standard SRK formula is used for average eyes.

We claim a better prediction result in our study population. This may be because of better measurement of axial length and keratometry or since there was no case of high hypermetropia or high myopia, chances of errors were minimum.

SRK FORMULA

According to Alpar JJ Fechner PU., real advantage of SRK formula as compared with Binkhorst , Colenbrander and the Gernet formula is questionable.

P. Mc Cormack et al . (1991) reported that prediction accuracy of IOL power is reduced in patients with axial myopia with SRK formula.

Oslen T (1992) hypothesised that minimal error in predicted refraction after implanting an IOL is the sum of random error in the estimate of axial length and the measurement of corneal power.

Holladay JT et. al. (1986) , said that the average error of the preoperative target refraction and the number of patients with errors greater than 2D did not differ significantly between Binkhorst and SRK formula.

Drews RC (1991) suggested that when the measurement obtained by two formulae disagree , the power that is closer to normal should be chosen.

Prior et al (1988) said that statistically significant difference were found between surgeons results , supporting the practice of "A" constant modification of individual surgeons.

Huber (1989) said that worst results were obtained with the standard SRK formula than with other formulae in high myopic groups.

In our study , we found that SRK formula was very accurate. This may be because we had excluded patients with high refractive errors.

Jaffe N.S. and Horwitz J describe that the advantage of SRK formula is its simplicity.

As we have not predicted the postoperative refraction by other formulas , the advantage of SRK formula over other formulas needs to be assessed .

SUMMARY & CONCLUSION

SUMMARY AND CONCLUSION

The present study was carried out in 60 cases of which 30 cases were taken as control group (Group A) in whom the posterior chamber intraocular standard lens was implanted and 30 cases were taken as study group (Group B) in which the posterior chamber intraocular lens of calculated power by SRK formula was implanted. The patients with history of high refractive errors were not taken

The accuracy of standard SRK formula has been assessed and the postoperative refraction results in Group A were compared with those in Group B to test the hypothesis that such calculations may be unnecessary as a standard power IOL may be relied upon to reproduce postoperatively the preoperative basic refraction , also attempt has been made to find out other factors if any influencing the post operative refraction results.

The study revealed :

1. By using standard SRK formula for IOL power calculation we could achieve a refraction within ± 1.0 D of the emmetropia in 74% cases in Group B, while in Group A we could achieve a refraction within ± 1.0 D of the emmetropia in 37% cases only.
2. In Group B , 100% patients were within ± 2.0 D of emmetropia which is better than the results reported earlier. We attribute the better results to :

a. Improvement and sophistication in modern equipments which lead to fairly accurate estimation by keratometry and biometry.

b. Extra precaution taken while recording measurements.

c. The patients with history of high refractive errors were not taken in the study.

3. the postoperative corrected visual acuity was similar in two groups whereas there was a significant difference in the uncorrected postoperative visual acuity in the two groups. This means that patients in Group A had higher post operative refractive error.

We therefore conclude that :

1. In all the cases , power of the IOL to be implanted should be calculated. Implantation of standard lens is not up to mark.
2. We could not conclude any other factor influencing the postoperative results except the standard factors (refractive power of the cornea, axial length , and the constant for each lens type and / or manufacturer).
3. SRK formula is most accurate if the preoperative refractive error is not high .
4. This study has been carried out in a small group of patients and on cases with low refractive errors, hence, we recommend more studies in a large group of patients with a wide range of refractive errors.

BIBLIOGRAPHY

BIBLIOGRAPHY

1.	Alpar JJ , Fechner PU.	Text book of Intraocular lenses: First Indian Edition , 1988
2.	Clevenger CE.	Clinical prediction versus ultrasound measurement of IOL power. Am Intraocular Implant Soc J ; 4 : 224 - 4 .
3.	Gregory PT ,Esbester et al .	Accuracy of routine intraocular lens power calculation in a district general hosptial . Br. J. of Ophthalmol . 1989 , Jan . 73 (1) : 57 - 60.
4.	Hillman Jeffery S .	Intraocular lens power calculations for emmetropia ; a clinical study . Br. J. of Ophthalmol . 1982 ; 64 : 53 - 56 .
5.	Hillman Jeffery S .	Intraocular lens power calculation for planned ametropia ; a clinical study . Br. J. of Ophthalmol . 1983 ; 67 : 255 - 258 .
6.	Hoffer KJ	Accuracy of Intraocular lens calculation . Arch Ophthalmol 1981 ; 99 : 1819 - 1823 .
7.	Hoffer KJ	Formulations improve IOL power calculation. Ocular Surgery News International . Vol. 7, Number 3 : March 1996 ; 12 - 13

8.	Holladay JT and Rubin ML.	Avoiding refractive problem in cataract surgery . surv Ophthalmol 1988 Mar -Apr ; 32 (5) : 357 - 68.
9.	Holladay JT ,Prager TC et al .	Improving the predictability of intraocular lens power calculation . Arch Ophthalmol ; 1986 Apr ; 104 (4) : 539 - 41 .
10.	Huber C	Effectiveness of Intraocular lens calculation in high ametropia . J Cataract Refract Surg 1989 ; Nov . 15 (5) : 667-72.
11.	Johns GE	Clinical evaluation of the DBR A - scan unit. Am Intraocular Implant Soc J 1979 ; 5 : 213 - 6.
12	Kraff MC , Sanders DR , Liberman HL.	Determination of Intraocular lens power : a comparison with and without ultrasound . Ophthalmic surg 1978; 9 : 81 - 4.
13.	Limdi NK and Sheth KJ	Prediction of intraocular lens power in 100 patients using the ophthasonic A scan unit . Indian J Ophthalmol 1991 Apr June ; 39 (2) : 50 - 2 .
14.	Longstaff S	Factors affecting intraocular lens power calculation . Trans Ophthal Soc , UK , 1986 ; 105 (pt. 6) : 642 - 6 .
15.	Maloney WF et ai .	Posterior chamber intraocular lens power calculation in 441

cases . Am Intraocular Implant Soc J 1979 ; 5 ; 349 - 350 .

16. Mc Cormack et al . An analysis of the accuracy of prediction of intraocular implant power in myopic patient . Eye 1991 ; 5 (pt. 1) : 63 - 5

17. Oslen T Sources of error in intraocular lens power calculations . J Cataract Refract Surg 1992 ; Mar 18 (2) : 125-9 .

18. Priori C , Ramsay RJ et al. IOL prediction : An evaluation of pre-operatively determined intraocular lens power accuracy. Am N J J ophthalmol 1988 May ; 16 (2) : 111-7 .

19. Piers Percival A colour atlas of lens implantation . Wolfe Publishing Ltd . , 1991 .

20. Salz J J and Reader AL , Lens implant exchanges for incorrect power ; Results of an informal survey . J cataract Refract Surg 1988 ; Mar 14 (2) : 221-4 .

21. Singh Mohinder and Dahalan Alias Significance of intraocular lens power calculation . Br J Ophthalmol 1987 ; 71 : 850-853

22 . Shammas H J Atlas of ophthalmic Ultrasonography and biometry 1984 ; C V Mosby.

23. Thompson SM & Roberts — A comparison of post operative refractive results with and without intraocular lens power calculation. Br J of ophthalmol 1986 ; 70 : 20 - 25 .

24. Peyman GA, Sander DR, Gold berg MF. — Principles and Practice of Ophthalmology Vol. Ist 360.

25. Javitt J, Sommer A, Venkataswamy G. — Acta XXIV International Congress of Ophth. , Philadelphia, J.B., 1983, pp 1308-1312.

26. Hiller R, Giacometti L, Yuen K . — Sunlight and Cataract, an epidemiologic investigation. Am J Epidemiol. 105 ; 450 , 1977.

27. Abrams D — Duke Elder's Practice of Refraction. First Indians Reprint 1995.

28. Cotlier E — The cornea. In Adler's Physiology of the Eye : Clinical Application. 1975.